Portable Instrumentation Lab

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Abstract—The rapid development in the research and innovation field was supposed to ease the workload of scientists and engineers, but the pressure has kept on building with larger magnitude, the reason being “Time”. As more and more sensors/transducers are being introduced in the market, engineers are having trouble to pick the best suited sensor for the application.

The most time consuming tasks are:

- Developing the signal conditioning PCB and data comparison schemas.
- Writing firmware for the controllers so as to read the specific characteristics.
- Need to rush to a costlier electronic work bench, every time we need to test a new sensor.

Hence, the objective is to develop a portable instrumentation lab to provide universal test bench for various sensors, which you can carry with you anywhere in the same way as you carry your laptop.

Keywords- test bench; sensor; characteristics; portable

I. INTRODUCTION

The existing instrumentation labs are all filled with different boards for different transducers [9] [10]. Thus if you need to test characteristics of ten sensors you will be required to work through around ten different boards. Moreover these boards need to be plugged in with a PC to save the reports. The PC needs to have dedicated software to study and compare the characteristics of these transducers. To conclude it is really hard to carry the whole lab set.

The success of the proposed system will allow us all, the access to a single compact portable motherboard, of the size of a laptop which one can carry anywhere, to provide universal test bench for various sensors. One can quickly and easily evaluate any sensor. The basic idea is to have a single system to test and verify the features, functions and characteristics of various sensors. The main objective is to reduce cost and time by testing various sensors under one roof.

The system shall also have a small thermal printer which can be used to print test results and plot graphs against two different transducers. The system will also have a graphical LCD to display real-time analysis and a user friendly GUI that can be navigated by a PS2 keyboard or a small 4x4 matrix keypad.

There is an aim that in near future this system will gain the same popularity as a DMM (digital multi-meter) in present time.

II. SYSTEM ARCHITECTURE

The proposed system is as follows:

1. The system will categorize all sensors/transducers such as Voltage transducers/current transducers etc…

2. The system will contain a high precision but compact motherboard with the most efficient ADCs (24 bit).

3. Microcontroller is the heart of the system, performing lots of functions. Few of them are
   - Display available test profile options configured in memory-card.
   - Scan all slots for available sensors.
   - Read calibration factor stored in memory card.
   - Perform real time interpolation of sensor data from selected sensors.
With the rapid development of the field of industrial process control and the fast popularization of embedded ARM processor, it has been a trend that ARM processor can substitute the single-chip to realize data acquisition and control. Proposed system is based on embedded ARM processor.

4. ADC should be able to interpolate data with the highest efficiency and accuracy.

5. Since the system needs to be portable, there should be a facility for viewing electrical characteristics / test report. Graphical monochrome LCD would serve the purpose.

6. Memory allows us to store the test profiles, calibration factors and off course the test results which can be further printed using thermal printer. 2 GB memory should be sufficient for storing over 20,000 test reports.

7. Fat 24 file system would be incorporated on the memory so that the files can be transferred to any OS (windows or Linux) and can be analyzed on the system. (Preferably using excel sheets).

8. The system will also have a printer interface so that one can take print outs of the test reports and attach to the report files, plot graphs for various profiles of the parameters etc. A small handy thermal printer would be best suited for the task.

9. The motherboard will have slots arranged category wise. One can plug and play sensors anytime by placing daughter cards/signal conditioning cards into those slots.

10. The system will also provide a user friendly GUI on the LCD using keypads for fast and easy operation of the device.

In a nutshell you will be able to carry your instrumentation lab with you anywhere in the same way as you carry your Laptops.
IV. FLOW CHART

Start

Initialize printer, graphical LCD, ADC System PLL, check RTC Data and display on LCD. Load file system on Memory Card.

If Memory Card Connected

No

Warn user for memory error

Yes

Stop

Display Available Profile options configured in memory card

Scan all slots for available sensors

Read Calibration factor stored in memory Card

Perform real time interpolation of sensor data from selected sensors

Ask user to print report

Save Report and return to main screen

Yes

Print and save Report and return to main screen

No

1. Laboratory Purpose

Sensor Characteristics Study

UTM Machines

Stress Strain Graphs

2. Industrial Purpose

CNC Machines

RTM Machines

Multi channel Data Loggers [1] [2].

Environmental Monitoring [7] [8].

VI. CONCLUSION

The successful completion of the project will ease the workload/pressure from the minds of scientists, engineers and students all alike. Thus they will be able to concentrate on bigger projects and contribute to the development/knowledge acquisition and thus benefit the humanity at a much better place.

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